THESIS FOR THE DEGREE OF LICENTIATE OF ENGINEERING

Health and Office Architecture

Exploring the salutogenic approach in the context of the physical office environment

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Abstract

The office, where many people spend most of their day, influences the health of employees, their families, communities, and society. While the body of research that relates office environment to health is growing, a question of interest for practitioners arises: how buildings should be designed and managed in order to support and promote health.

This thesis adopts a salutogenic perspective in physical office environments. The salutogenic approach is an orientation toward health that focuses on the origins of health rather than on the determinants of disease. Salutogenesis indicates that the factors that create health are often different from those that cause illness. In this perspective, 'sense of coherence' has been found to be a resource for health promotion. However, the previous research concerning health in offices has tended to focus on the negative impacts of physical office environments (pathogenic) and less research has been carried out on the components that create and maintain health (salutogenic).

The research work included two literature reviews and a mixed-method case study approach. First, health and healthy offices are studied in the context of office design approaches to explore how health is understood in the literature. Additionally, the Nordic perspective is specifically studied as a complementary setting to gain a deeper understanding of healthy office conceptualizations. While the literature provides input from the scientific perspective, the case study approach was used to explore the sense of coherence theory in an architectural context.

The findings first revealed that conceptualizations of health and healthy offices were not abundant, and most approaches were limited to a pathogenic perspective. Second, design strategies were often formulated with little consideration of contextual factors. That is, no holistic office design approach was found to address all design features and health aspects. Finally, from a sense of coherence perspective, manageability and meaningfulness were the most recurrently influenced components, mainly by a sense of control, ownership, and opportunities for social interactions. Comprehensibility was also influenced, nevertheless, largely by the lack of behavioral rules and clarity. Contextual factors, such as the organizational work culture, facility management style, individual preferences, and activities were critical to elucidate the findings.

To conclude, the findings highlight the need for holistic approaches that go beyond the mitigation of pathogenic aspects and promote the salutogenic resources of the physical office environment in order to strengthen employees' sense of coherence and empower them to more positively and adaptively deal with stressors. As such, the move toward the healthy continuum in office environments involves two complementary strategies. First, modifications can be made to the office aimed at alleviating risk factors (e.g., improving air quality) and second, maximizing the presence of salutogenic resources (e.g., optimizing a sense of control).

Keywords: Architecture, Case study, Design approach, Employee, Health, Nordic, Office design, Physical office environment, Productivity, Qualitative study, Salutogenic, Sense of coherence, Well-being, Workplace.

Sammanfattning

Kontoret, där många tillbringar större delen av sin dag påverkar hälsan för anställda, deras familjer och samhället. Allt eftersom forskning om samband mellan kontorsmiljö och hälsa växer, uppstår frågan: hur bör byggnader utformas och hanteras för att dessa ska stödja och främja hälsan.

Denna avhandling antar ett salutogent perspektiv på hälsa i fysiska kontorsmiljöer. Den salutogena hållningen inriktar sig mot hälsa och fokuserar på grunden för hälsa snarare än på determinanterna för sjukdom. Salutogenes antyder att de faktorer som skapar hälsa ofta skiljer sig från de som orsakar sjukdom. I detta perspektiv har känsla av sammanhang visat sig vara en resurs för att främja hälsa. Dock har tidigare forskning kring hälsa på kontor tenderat att fokusera mer på de negativa effekterna (patogent) av fysiska kontorsmiljöer på hälsan, och mindre forskning har genomförts på de faktorer som skapar och bibehåller hälsa (salutogent).

Forskningsarbetet inkluderade två litteratursammanställningar och en blandad fallstudiemetod. Först studerades hälsa och hälsosamma kontor i sammanhanget av kontorsutformning för att undersöka hur hälsa definieras i litteraturen. Utöver detta studerades det nordiska perspektivet specifikt som ett komplement för att få en helhetsförståelse för ”hälsosamma kontor” som koncept. Medan litteraturen ger input från det vetenskapliga perspektivet, användes fallstudiemetoden för att utforska känsla av sammanhang i en arkitektonisk kontext.

Resultaten visade för det första att konceptualiseringar av hälsa och hälsosamma kontor inte fanns i överflöd, och att de flesta angreppssätten var begränsade till patogena perspektiv. För det andra formulerades designstrategier ofta med liten hänsyn till kontextuella faktorer. Det vill säga, ingen holistisk kontorsdesignmetod hittades för att adressera alla designfunktioner och hälsoaspekter. Slutligen, ur känsla av sammanhangs perspektiv, var hanterbarhet och meningsfullhet de komponenter som påverkades mest återkommande, främst av känslan av kontroll, ägandeskap och möjlighet till sociala interaktioner. Begriplighet, påverkades dock till stor del av bristen på beteendevillkor och tydlighet. Kontextuella faktorer, såsom organisationens arbetskultur, fastighetsförvaltning, individuella preferenser och aktiviteter var avgörande för att klarlägga resultaten.

Avslutningsvis markerar resultaten behovet av holistiska synsätt som går utöver en minskning av patogena aspekter och främjande av salutogena resurser i den fysiska kontorsmiljön i syfte att stärka de anställdas känsla av sammanhang och ge dem styrkan att på ett mer positivt och adaptivt sätt hantera stressfaktorer. Övergången mot hälsosamma kontinuum i kontorsmiljöer innefattar två komplementära strategier. Den första är att göra fysiska modifikationer i syfte att minska riskfaktorerna (t.ex. förbättra luftkvalitén) och den andra är att maximera närvaron av de salutogena resurserna (t.ex. optimera känslan av kontroll).

Nyckelord: Anställd, arbetsplats, arkitektur, designstrategi, fallstudie, fysisk kontorsmiljö, hälsa, kontorsutformning, kvalitativ studie, känsla av sammanhang, nordisk, salutogena, välbefinnande.

List of included publications

Paper 1

Forooraghi, M., Miedema, E., Ryd, N. and Wallbaum, H. (2020), "Scoping review of health in office design approaches", *Journal of Corporate Real Estate*, Vol. 22 No. 2, available at: https://doi.org/10.1108/JCRE-08-2019-0036.

Forooraghi planned and designed the database search, reviewed the literature, and wrote the paper. Miedema contributed to the analysis, the writing and provided feedback. Ryd contributed to the analysis and provided feedback. Wallbaum provided feedback.

Paper 2

Forooraghi, M., Wallbaum, H. and Ryd, N. (2019), Health and well-being in offices - A study of literature on the Nordic perspective. *In*: IOP Conference Series: Earth and Environmental Science, Vol. 297, p. 012013., available at: https://doi.org/10.1088/1755-1315/297/1/012013.

Forooraghi planned the paper, designed the literature search, reviewed the literature, wrote the paper and presented it at the conference. Wallbaum and Ryd contributed to the planning, and provided feedback.

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Thank you to the moon and back!

Melina Forooraghi, May 2020

Preface

Studying architecture, I always found the starting point of a design task to lie in its users. This user focus became even more evident in my master's studies when I was able to familiarize myself more profoundly with the social aspects of sustainable development, more specifically the human experience in design processes and buildings. In my master's thesis, I studied how building façades can improve occupants' comfort in office buildings in a cost-efficient and environmentally responsible manner, which opened the door to a vast body of knowledge about humans and their complex interaction with buildings. The idea of considering the needs of a building's occupants extended my thinking into how buildings influence us in various ways, namely through our health.

Today, health is not just the duty of health care staff anymore; many other sectors of society have a responsibility to promote health. The right to health is a broad concept that includes many different entitlements, one of which relates to a healthy built environment, specifically buildings (Figure 1). This is also embedded in the core principle of the *2030 Agenda for Sustainable Development* ensuring that no one is left behind. From the current pandemic crisis, it is more than evident that our societies are complex and interrelated. The need to study health from a societal perspective rather than that of the individual is imperative. Tedros Adhanom Ghebreyesus, Director General of the World Health Organization, stated the following on Human Rights Day in 2017:

> *"I call on all countries to respect and protect human rights in health—in their laws, their health policies and programs. We must all work together to combat inequalities and discriminatory practices so that everyone can enjoy the benefits of good health, no matter their age, sex, race, religion, health status, disability, sexual orientation, gender identity or migration status."*

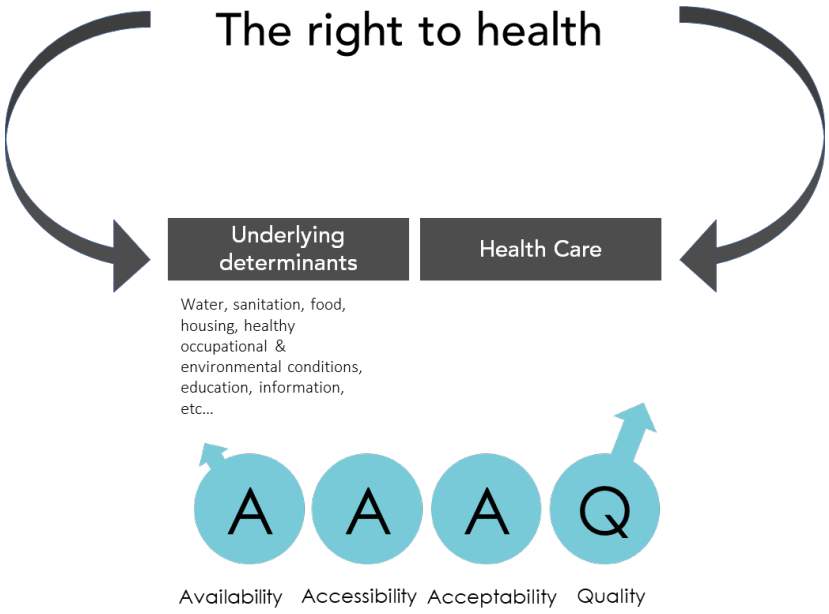

Figure 1. The right to health (adapted from WHO, 2009)

Elke Miedema, my colleague and friend, introduced me to the concept of salutogenesis. I especially became fascinated by Antonovsky's effort to understand why some concentration camp survivors seemed healthy and well-adapted despite their traumatizing experience (Antonovsky, 1979; Lindström and Eriksson, 2006). He assumed that some people develop a 'sense of coherence': overcoming challenges by understanding the character of the problem, and identifying and deploying relevant resources (Eriksson and Lindström, 2008; Allen, Boddy and Kendall, 2018). This intrigued me to ask the following question: 'How can we design buildings to strengthen people's ability to access the resources they need to manage life stressors?'

Antonovsky (Antonovsky, 1996) used the 'Health in the River of Life' analogy to best illustrate the distinction between care and treatment with prevention and promotion. In this analogy, he indicates that it is not enough to build bridges to keep people from falling into the river (Eriksson and Lindström, 2008). Instead, it is necessary for people to learn to swim, a shift in perspective that is much needed regarding the way we design and maintain the built environment.

I feel privileged to have the opportunity to dig deeper into my personal curiosity and fortunate to have resourceful supervisors who trust my intuition to explore, in this licentiate thesis, how health and healthy offices are conceptualized and how the physical office environment influences peoples' sense of coherence.

Research context

This work was carried out at the Chalmers University of Technology, Department of Architecture and Civil Engineering. The point of departure for my research was the project 'Smart Sustainable Offices' (SSO) that was funded by EIT-Climate KIC and ran from 2014 to 2019. The SSO project originated at ETH Zurich in Switzerland, where studies of 27 office buildings began in 2010. The research team included an interdisciplinary group of researchers from psychology, architecture, industrial design and environmental engineering. The project aimed to improve the health, well-being and productivity of employees while addressing challenges related to office planning, evaluation and intervention. This multimethod approach led to the development of multiple tools for data collection, including a questionnaire, diary, in-depth interviews, and on-site observations, in addition to physical measurements of indoor environmental quality. All these methods contributed to the collection of extensive datasets related to, e.g., employee satisfaction, work conditions, personal life and preferences, work patterns, indoor environmental quality, energy consumption and demographics. Working with the SSO project and the research team has been a valuable academic and learning experience and critical for my doctoral education.

Terminology

Contextual factors	The nonphysical factors that relate to the context of the organizations, individuals and work processes, e.g., organizational culture, employee personality, gender, and activity patterns.
Design approach	A method of building design with certain goals in mind, relating to theory, occupants and expected outcomes.
Generalized resistance deficits	The deficits of a person, group, or community that hamper the individual's ability to effectively cope with stressors.
Generalized resistance resources	The resources of a person, group, or community that facilitate the individual's ability to effectively cope with stressors.
Health	The ability to adapt and to self manage in the face of social, physical and emotional challenges, which includes six interrelated dimensions: bodily functions, mental functions and perception, spiritual/existential dimension, quality of life, social and societal participation, and daily functioning.
Interrelation	Mutual or reciprocal relations between two or more elements that are connected and affect one another.
Physical office environment	Every material objects and stimuli that people encounter in their work, including features such as building design, room size and layout, furnishings, material and equipment, and indoor environmental quality such as noise, lighting or air quality.
Salutogenesis	An orientation toward health that focuses on factors that create health rather than factors that cause illness.
Sense of coherence	A combination of peoples' ability to assess and understand the situation they are in (comprehensibility), to find meaning to move in a health-promoting direction (meaningfulness), and to have the capacity to do so (manageability).

Acronym

IEQ	Indoor environmental quality
ODA	Office design approach
POE	Physical office environment
SOC	Sense of coherence
WHO	World Health Organization

Contents

Chapter 1
Introduction

The built environment influences people's health (Barton and Grant, 2006; Villanueva *et al.*, 2013). The office, where many people spend most of their day, is an important place for developing and maintaining the health of employees (Jones, 2018; Lee, 2019), their families, communities, and society (Chu *et al.*, 2000). While the body of research that relates the office environment to employee health is growing (World Green Building Council, 2014; Clements-Croome, 2018; Jensen and van der Voordt, 2019, for review), a question of interest for practitioners arises: how buildings should be designed and managed in order to support and promote health.

The World Health Organization (WHO,1948) defines health as *"a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*". This definition reflects a distinction between harm-causing (pathogenic) and health-promoting (salutogenic) factors (Roskams and Haynes, 2019). However, as revealed by recent literature reviews (Groen, Jylhä and van Sprang, 2018; Jensen and van der Voordt, 2019; Colenberg, Jylhä and Arkesteijn, 2020), most studies focus on alleviating the negative effects of the physical office environment on employees, overlooking the health-promoting potential of the work environment.

The physical office environment (POE) comprises every material objects and stimuli that people encounter in their work, including features such as building design, room size and layout, furnishings, material and equipment, and indoor environmental quality such as noise, lighting or air quality (Davis, 1984; Davis, Leach and Clegg, 2011; Sander, Caza and Jordan, 2019). In recent years, there has been a growing interest in the field of POE research in connection with health-related outcomes. A great deal of research in this area belongs to the study of indoor environmental quality (IEQ), which has investigated light, noise, air quality, and odor in relation to employees' concentration, long-term sick leave, perceived comfort and satisfaction, and symptoms such as mental fatigue, body stiffness, and eye, nose and throat irritation (Clausen *et al.*, 2009; Frontczak and Wargocki, 2011; Kim and de Dear, 2013; Clements-Croome, 2015; Al

horr *et al.*, 2016; Bluyssen *et al.*, 2016). These irritative symptoms have been associated with sick building syndrome; a situation in which 20 percent of building occupants complain of a similar medical condition, while in the building, due to an unknown cause over a period of at least 2 weeks (Clements-Croome, 2011).

Several studies have reported on the impact of spatial features, e.g., various office types on general health, well-being and sick leave rates (e.g., De Croon *et al.*, 2005; Danielsson and Bodin, 2008; Pejtersen *et al.*, 2011). For instance, traditional open plan offices have been associated with increased environmental stressors, a higher risk for ill health and sick leave compared to in cell offices. Additionally, interior design choices, including the elements of the natural environment, such as plants and views outside, furnishing, materials, colors and overall esthetics, are studied in relation to perceived productivity, social cohesion, creativity, mood and well-being (Bauer, 2007; Smith and Pitt, 2009; Bakker and van der Voordt, 2010; Bakker *et al.*, 2013; Cooper and Browning, 2015; Smith, Fsadni and Holt, 2017). For instance, Smith and Pitt (2009) found that employees in offices with plants felt more comfortable, healthy, and creative, and felt less pressure than employees in offices with no plants.

Sociospatial features, including feelings of belonging, ownership and control over the workspace, have been widely studied in the literature (e.g., Elsbach and Pratt, 2007; Vischer, 2008b; Ashkanasy, Ayoko and Jehn, 2014). For example, the lack of a sense of control over stressors, such as noise, disturbances and visual distractions is linked to negative effects on employee well-being, job satisfaction and motivation (Evans and Johnson, 2000; Banbury and Berry, 2005; Kim and de Dear, 2013), leading to learned helplessness (McCoy and Evans, 2005). Additionally, autonomy (employees' control of work time and place; e.g., Demerouti *et al.*, 2014) has been supported by a variety of workspaces that allow employees to match their choices to their activities, preferences and needs (Appel-Meulenbroek, Groenen and Janssen, 2011; Bodin Danielsson *et al.*, 2014).

In addition to the features of the POE, a number of studies have identified contextual factors related to the characteristics of the organization, individuals, their tasks and activities and the process of change that may influence employees' interaction with their environment. For instance, individual characteristics of employees refer to personality, age, gender and personal preferences. Some studies have shown that male employees complain more about the lack of possibilities for workspace personalization in activity-based flexible offices (Volker and van der Voordt, 2005) and are more likely to take sick leave (Bodin Danielsson *et al.*, 2014) than are female employees. Additionally, the characteristics of employees' tasks and activities, e.g., the degree of task complexity or variety can have specific environmental requirements and thereby have been found to be critical to the success or failure of an office design (Greene and Myerson, 2011; Haynes, 2012; Bruyne and Beijer, 2015; Soriano *et al.*, 2020).

Against this background, less research has been carried out on the components of the POE that create health and how they are interrelated. As shown by a recent systematic review of 134 empirical studies in the POE filed, only one-third of the studies focused on health, and the outcome measures largely concerned ill health, stress, sick building syndrome and fatigue (Appel-Meulenbroek, et al., 2018). Therefore, many scholars have called for more enabling approaches to building design and offices, one that goes beyond (just) preventing people from getting ill or feeling bad and focuses on improving the quality of their life (Heerwagen *et al.*, 1995; Vischer, 2008a; Bluyssen, 2014; Ruohomäki, Lahtinen and Reijula, 2015; Clements-Croome, Turner and Pallaris, 2019; Roskams and Haynes, 2019).

This thesis is a response to calls for a paradigm shift and studies the particular role of 'health' within the context of the POE, and to what extent academic endeavors in the published literature help shed light on this.

The salutogenic approach

The WHO has been an advocate for a positive conceptualization of health, in which every human being has the right to enjoy the highest possible standard of physical, mental and social well-being, regardless of their socioeconomic circumstances, ethnicity or beliefs (WHO, 1984,2006). Several conceptual frameworks and instruments have been developed to describe and explain the most positive part of the health continuum, one of which is salutogenesis.

The salutogenic model, developed by Antonovsky (1987, 1996), is an orientation toward health that focuses on the origins of health rather than the determinants of disease (pathogenic). Salutogenesis indicates that the factors that create health are often different from those that cause illness. Health, in the salutogenic model, is movement on a continuum of 'health-ease' and 'dis-ease' (Eriksson and Lindström, 2006). Antonovsky introduced the sense of coherence (SOC) theory to answer the question of why some people remain healthy in stressful life situations, and others do not (Eriksson and Lindström, 2006). SOC is a combination of peoples' ability to assess and understand the challenge they are facing, to find a reason to move to the health end of the continuum, and to have the capacity to do so, referred to as comprehensibility, meaningfulness, and manageability, respectively (Eriksson, 2016).

The study of the POE could contribute to a better understanding of the effects that the environment has on employees' sense of coherence. Furthermore, the study of the POE from an architectural design perspective provides a basis for identifying design criteria beyond comfort and buildings to incorporate human experience.

1.1. Aim and Scope

The *aim* of this thesis is to explore the interrelations between the POE and the positive aspects of health to support the development of healthy offices.

In this thesis, the office is considered a complex sociotechnical system, the performance of which highly depends on the interactions among a number of interrelated parts, including technical, human, social, organizational, managerial and environmental aspects (Davis, Leach and Clegg, 2011). Nevertheless, the scope of this work concerns the physical environment, and nonphysical factors are only reported when found relevant to contextualize the findings concerning the physical environment.

To address the aim outlined above, three research questions were formulated. These questions specifically focus on: (i) office design approaches, (ii) conceptualizations of health and healthy offices in the literature, and (iii) the influence of the POE on employees' SOC. The research questions are motivated as follows.

1.2. Development of research questions

In recent years, accumulating evidence on building-user interactions has shifted architectural design from a focus on designers' intuition and experience to a more holistic and complex process as it seeks to embrace the multidimensional aspects of such interactions.

Correspondingly, various design approaches have been developed as methods for building design, with certain goals in mind, relating to theory, occupants and expected outcomes. While design approaches are widely used to create healthy environments in other settings (e.g., health care building design), less is known

about how office design approaches (ODAs) relate to various aspects of health. ODAs may be a useful resource for addressing health and developing healthy offices; therefore, the first question focuses on health and healthy offices as conceptualized by ODAs in the literature:

RQ1. How do office design approaches relate to health and healthy offices?

Nordic countries have a worldwide reputation for their high living and working standards. Not only do the Nordics offer equal opportunities and a good work-life balance, their approach to workplace design is also acknowledged by leading professionals and Nordic workplaces are often seen as the frontrunner of the development of office concepts (Myerson, et al., 2015).

That said, similar to most countries, the Nordics have been facing global public health challenges, such as an aging population, a rise in long-term conditions (e.g., cancer, respiratory problems, and mental illness), and high demands on health care resources. These challenges necessitate a combination of resourceful thinking and innovative approaches for building design, namely, offices.

Given the striking similarity of Nordic societies, it is important to acknowledge the profound differences between them as well. For instance, the diverse reactions of the Nordics to Covid-19 have revealed the different ways in which each country is run, particularly with respect to the relationship between the government and administrative authorities. Nevertheless, considering their cultural and socioeconomic similarities in comparison to other European countries, regional approaches to workplace design may be beneficial for research purposes. The second research question, therefore, focuses on Nordic research:

RQ2. How is health addressed in relation to the POE from a Nordic perspective?

The SOC theory is a useful resource for health promotion in the salutogenic orientation. Few studies have attempted to relate salutogenesis and the SOC framework to health care building design (e.g., Golembiewski, 2010, 2012). In the POE research, however, the salutogenic model has received even less attention, with few authors referring to the model without explicitly providing design implications (e.g., Heerwagen *et al.*, 1995; Ruohomäki *et al.*, 2015). One recent literature review addressed opportunities in office design that can support SOC and highlighted the need for more empirical studies to identify health-promoting (salutogenic) resources in the work environment (Roskams and Haynes, 2019). This review called for more empirical research on the application of SOC in workplace design. Furthermore, the risks and symptoms caused by the work environment can take days, weeks or months to manifest themselves (Heerwagen *et al.*, 1995); thus, to create long-lasting positive outcomes, it is imperative to study offices over time. The third question, therefore, addresses the interrelation between the POE and employee SOC with a focus on temporality:

RQ3. How does the POE influence employee SOC in the long term?

1.3. Thesis structure

Chapter 1 presents a brief summary of the previous research relating the POE to health. Subsequently research gaps and the specific aim for this thesis are outlined, and the respective research questions are motivated.

Chapter 2 first reviews definitions of health and a healthy office. Then the salutogenic approach and its key concepts are described. Finally, an overview of previous research in the context of the POE is interpreted from an SOC perspective.

Chapter 3 describes the chosen methods for the three studies included in the thesis.

Chapter 4 presents the findings to answer the research questions concerning ODAs, health and healthy office conceptualizations as found in the literature as well as the interrelations between the POE and employee SOC in the long term.

Chapter 5 discusses these findings while outlining the research scope and respective limitations.

Chapter 6 presents a summary of the findings, followed by implications for future research. This chapter concludes with an overview of the identified topics to be investigated until the end of the Ph.D. project.

In addition to the 6 chapters, there are two papers that are appended to this thesis.

Chapter 2
Theoretical Framework

In this chapter, first, the conceptualizations of health and a healthy office are described. Then, the salutogenic approach and sense of coherence are reviewed. Finally, an overview of research findings in the context of the POE is interpreted from an SOC perspective which has resulted in a framework for further analysis.

2.1. Health and a healthy office

There is a wide variety of definitions of health. For instance, in the biomedical context, health is often defined as the mere absence of disease. In this way, disease is typically defined as physiological malfunction which translates into a medicine exclusively dealing with the physical aspects of illness (Farre and Rapley, 2017). In contrast, the WHO (1948) defines health as "*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*". Although this definition has been criticized for being overly static and idealistic, especially as it relates to the word "complete", very importantly, it broadens our perspective on health from the mere absence of disease to include the physical, mental, and social dimensions. Other scholars have worked with more dynamic conceptualizations of health based on the resilience or capacity to cope (Huber et al., 2011). This thesis adopts the definition of health, proposed by Huber et al. (2016), as "*the ability to adapt and to self manage in the face of social, physical and emotional challenges*". This definition includes six interrelated dimensions: bodily functions, mental functions and perception, spiritual/existential dimension, quality of life, social and societal participation, and daily functioning.

Similarly, the definitions of a healthy workplace have also evolved over the past few decades. The WHO (2010) describes a healthy workplace as follows:

"a place where everyone works together to achieve an agreed vision for the health and well-being of workers and the surrounding community. It provides all members of the workforce with physical, psychological, social and organizational conditions that protect and promote health and safety. It enables managers and workers to increase control over their own health and to improve it, and to become more energetic, positive and contented".

This definition reflects an evolution from an almost exclusive focus on traditional occupational health and safety, which dealt with physical, chemical, biological and ergonomic hazards (pathogenic), to include health practice factors, psychosocial factors, and a link to the community, all of which profoundly affect employee health (WHO, 2010).

2.2. Salutogenesis and sense of coherence

Antonovsky, a medical sociologist, in studying health instead of disease introduced a new concept: "salutogenesis— the origins (genesis) of health (saluto)" (Antonovsky, 1979). Antonovsky was intrigued by the question: what are the origins of health? He correspondingly answered: "The origins of health are to be found in a sense of coherence" (Antonovsky, 1979), which he later defined as follows (Antonovsky, 1987):

"The sense of coherence is a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable, and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement."

Antonovsky considered the SOC as the key concept of the salutogenic model comprising three interrelated components: (1) comprehensibility, (2) manageability, and (3) meaningfulness (Figure 2).

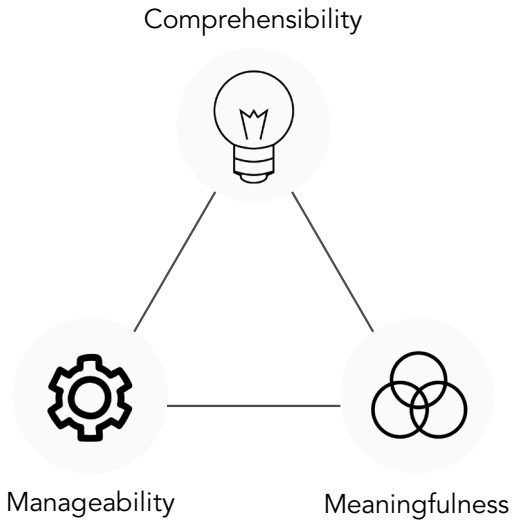

Figure 2. An illustration of three (interrelated) components of SOC

Comprehensibility means that a person can deal with stressors in life, only when they feel they have a clear understanding of the character of the problem (Antonovsky, 1990). Manageability as Antonovsky underlines is "*the sense that adequate resources to cope with the stressors are to be found either in one's own hands or in the hands of legitimate others*" (Ibid). Meaningfulness is the third yet most crucial component of the SOC and is understood in the emotional sense as "*a way of looking at life as worth living, of seeing stressors as perhaps painful and yet worthy of being coped with […] providing the motivational force which leads one to seek to order the world and to transform resources from potential to actuality*" (Ibid).

Based on his research on the salutogenic approach, Antonovsky found that not all stress will necessarily have adverse effects and the way we deal with stressors in life depends on our sense of coherence. In fact, he indicated in his work that life is a chaos and how we are able to manage this chaos is vital (Antonovsky, 1992):

> *"... life is inherently full of stressors, with life-situation stressor complexes by far deserving most of our attention of we wish to understand either health or disease. Focusing on health, I expressly rejected the implicit assumption that stressors are inherently pathogenic. Their health consequences can only be understood if we understand the coping process."*

When confronted with stress in life, people are either (1) neutral toward stressors, (2) able to manage stress, or (3) unable to manage stress, which leads to disease and death (Antonovsky, 1987). The SOC determines an individual's ability to cope effectively with stressors and subsequently their position on the health continuum. This movement toward the health end is either facilitated or impeded by generalized resistance resources (GRRs) or generalized resistance deficits (GRDs); the resources or deficits of a person, a group, or a community that contribute to or hinder the development of the individual's level of SOC (Antonovsky, 1979, 1987). These resources fall into three (interrelated) domains—those that enhance comprehensibility, those that enhance manageability, and those that enhance meaningfulness. These resources may include, for example, material resources (e.g., money), coping strategies, knowledge, social support, commitment and cohesion with one's cultural roots (Ibid).

The relationship between SOC and health has received much attention and is now well established. A variety of studies indicate that a strong SOC is linked to more healthy behaviors, more resilience and motivation to cope with stressors, good perceived health and quality of life (Eriksson and Lindström, 2007; Braun-Lewensohn *et al.*, 2016; Koelen, Eriksson and Cattan, 2016; Idan *et al.*, 2017). Moreover, SOC is strongly related to mental health and is associated with a higher level of optimism, self-esteem, and control and a lower level of depression, anxiety, and hopelessness (Eriksson and Lindström, 2006).

The work of Antonovsky is directed not only to his colleagues in medical sociology (the context from which salutogenesis is originated) but also to sociologists, psychologists, psychiatric nurses, physicians, health care organizers, epidemiologists, community organizer and architects, as well as those who, professionally and personally, are committed to understanding and enhancing the adaptive capacities of human beings (Antonovsky, 1979; Vinje, Langeland and Bull, 2016).

2.3. Office design from the sense of coherence perspective

Considering the amount of time that we spend at work, working conditions, including the POE, are important determinants of an employee's SOC and hence of a person's, a family's, and even a community's

health. The POE can be seen as a resource that contributes to the development of employees' sense of coherence. Although research on the application of salutogenesis to the studies of the POE is scarce, there are research findings that from a salutogenic perspective, are of immense importance. Hence, this work draws on the architectural extrapolation of the salutogenic theory proposed by Golembiewski (2010) and Roskams and Haynes (2019) and reinterprets some of the architectural elements for the office context as summarized in Figure 3.

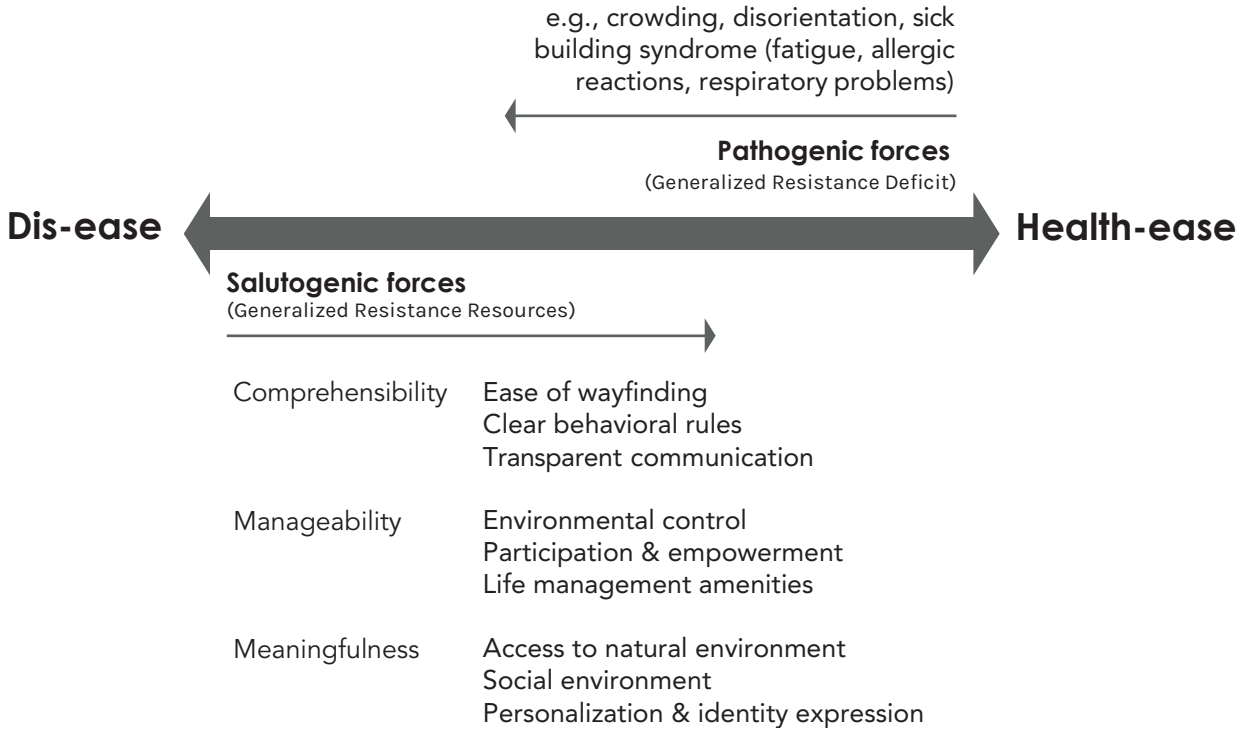

Figure 3. The SOC framework in the context of the OPE, adapted from Golembiewski (2010) and Roskams and Haynes (2019).

Comprehensibility and the POE

Comprehensibility is the capacity to understand and negotiate the contexts that we find ourselves in (Golembiewski, 2016). A highly comprehensible office evokes a sense of confidence to its users signaling that the work environment is structured, predictable and explicable (Antonovsky, 1987). Comprehensibility in the POE can be fostered through good wayfinding, clear behavioral rules, and transparent information sharing before and after an office relocation.

Spatial comprehensibility has particular relevance for wayfinding in complex office buildings. Poor wayfinding and disorientation are architectural elements of space that have important implications for a person's level of stress, anxiety, and effectiveness in coping (Danko, Eshelman and Hedge, 1990). People tend to use landmarks, boundaries, nodes, and colors to navigate in buildings (Oseland, 2009). A comprehensible space will have cues and signs and is psychologically accessible. For example, a recognizable entrance, clear functional zoning, and differentiation in the use of colors and materials enable easy navigation (Van Der Voordt, Vrielink and Van Wegen, 1997).

Behavioral rules are often necessary for structure and predictability. Desired behaviors might be discussed among employees on how different office zones should be used. While many organizations set behavioral

protocols and rules for workspace use, the research findings suggest that these rules may not work as well as intended. For example, a case study associated noncompliance with rules with their ambiguity, but subsequently involving users in the design process and making rules more explicit resulted in increased acceptance, higher compliance and employees feeling more secure in their choice of actions (Babapour and Rolfö, 2019).

Finally, when a relocation takes place, it is often unclear to employees what a change in work environment will mean for them. Transparency and predictability are necessary during a change process, for example, by informing early on and continuously about the change, the next steps, the status, and the results (Lahtinen *et al.*, 2015; Kämpf-Dern and Konkol, 2017). Communication should be accessible and understandable and explain the purpose of office relocation and how the employees will be affected by the change (Ibid).

Manageability and the POE

In the work environment, manageability reflects the feeling that a person is in control of their environment and their work. Manageability in the context of the POE can apply to a sense of control over the surrounding environment (e.g., tools, resources, and stimuli), participation and empowerment, and life management amenities.

A sense of control is a broad concept and is recognized in the literature as an established driver of well-being and happiness at work (Myerson and Ramster, 2017). Control can refer to the freedom of choice in perceiving visual and acoustic stimuli, as well as isolation from unwanted observation and background noise, also known as visual and acoustic privacy (Van Der Voordt, Vrielink and Van Wegen, 1997; Kupritz, 1998). Visual privacy and acoustic privacy enable people to regulate the level of social contact that people need; dissatisfaction occurs when the situations deviate from what a person considers optimal (Kupritz, 1998). There is good evidence to suggest that insufficient control over environmental stressors such as noise, disturbances, and visual distractions could negatively impact employee well-being, job satisfaction and motivation (e.g., Evans and Johnson, 2000; Banbury and Berry, 2005; Kim and de Dear, 2013). Furthermore, providing people with opportunities to control their environment improves thermal and visual comfort and overall satisfaction with air quality (Frontczak and Wargocki, 2011).

Another form of control is empowerment through increasing opportunities for employees to participate in the decision-making process (Vischer, 2008b). Research evidence is fairly consistent in linking the levels of control and empowerment associated with participating in design decisions to higher levels of well-being (e.g., Dewulf and van Meel, 2002; Vischer, 2008b; Myerson and Ramster, 2017). It is also suggested that the feeling of empowerment impacts the sense of belonging or ownership over employee's workspace contributing to what Vischer (2008b) terms 'psychological comfort (Vischer, 2005, 2008b).

Finally, life management amenities include resources that help employees balance the pressure of work and home, and refer to a wide array of services, such as childcare or work autonomy, both representing important outlets for stress relief and mental relaxation (Danko, Eshelman and Hedge, 1990).

Meaningfulness and the POE

Meaningfulness in the work environment refers to the extent to which one feels that the stressors of the environment are worthy of investment and engagement (Antonovsky, 1987). The workplace can be an ideal place to affirm meaning as many seek meaning in their careers and professional life. Previous research has

linked work meaningfulness to higher overall well-being, job satisfaction, and greater life meaningfulness (Wrzesniewski *et al.*, 1997; Arnold *et al.*, 2007; Dik and Steger, 2008). In the POE, meaning can be fostered through environmental richness, connection to natural environment, a sense of ownership and social relationships.

In a multisensory environment that is rich in complexity, different spatial components ranging from objects (desks, chairs) to the form and layout of building, spaces for social interaction, together with the workplace culture, all interact to create a multisensory experience (Clements-Croome, Turner and Pallaris, 2019). Previous studies have made important associations between the connection to the natural environment and positive health outcomes. An office environment that is enriched by colors, materials, art, and elements of the natural environment, such as daylight, views and/or access to natural landscape, and indoor plants are often associated with higher perceived well-being, satisfaction with esthetics, greater perceptions of workplace quality, better attention capacity and reduced stress (Kaplan, 1995; Lohr, Pearson-Mims and Goodwin, 1996; Bauer, 2007; Smith and Pitt, 2009; Raanaas *et al.*, 2011; Bakker *et al.*, 2013; Nieuwenhuis *et al.*, 2014). In a survey, the five most desired elements in the office were linked to the elements of the natural environment such as indoor plants, daylight and views of natural landscapes (Cooper and Browning, 2015). It is suggested by evolutionary psychology that positive associations with biophilia occur because of the tendency to be affiliated with life and the natural environment (Oseland, 2009). It is also commonly believed that our kinship with nature could be due to the fact that we find meaning in nature (Golembiewski, 2010).

Another way in which the POE can foster meaning is through promoting a sense of ownership through space personalization. The postulate is that personalization is a form of affirming meaning by adding visual cues. There is significant evidence to suggest that a sense of ownership and the personalization of the workspace can positively influence well-being, employee attitudes, and relationships among employees (Wells, 2000; Pierce, Kostova and Dirks, 2001; Brown, Lawrence and Robinson, 2005; O'Driscoll, Pierce and Coghlan, 2006). The environments enriched by employees with plants, artwork, and personal items that reflect personal relationships with family and friends have a greater effect on their psychological comfort, autonomy and job satisfaction compared to environments enriched by others (Wells and Thelen, 2002; Knight and Haslam, 2010). Artifacts and symbols of cultural and group identity are examples of meaningful resources that can promote a collective sense of meaning (Heerwagen *et al.*, 1995). Furthermore, a considerable number of workplace changes are often met with resistance (Laframboise, Nelson and Schmaltz, 2002; Vischer, 2005; Kämpf-Dern and Konkol, 2017). People often experience a loss during a relocation as a result of emotional bonds with their physical environment, for example, a personal space, a crafted environment or valued items and facilities, termed "place attachment" (Inalhan and Finch, 2004). Additionally, physical changes usually require people to change their work processes and behavior. Hence, it is imperative to address psychological and emotional reactions and provide resources for coping during and after an office relocation process.

Finally, there is little doubt that meaning is similarly found in social relations. Social interaction and collaboration are vital for all organizations, with no exceptions. The physical layout of the office influences patterns of social interaction and thereby shapes the social and relational aspects of work as it facilitates or restricts with whom and how often one interacts (Davis, Leach and Clegg, 2011) through, e.g., proximity, social spaces, functional distance between spaces and how spaces are interconnected via doorways and passages (Ruohomäki, Lahtinen and Reijula, 2015).

In summary, this chapter reviewed the key concepts of salutogenesis, demonstrated how they relate to the built environment, and presented a framework adapted from the previous interpretations of the SOC in the architectural context. The research approach for this thesis is presented in the next chapter.

Chapter 3
Method

Exploring the interrelations between the POE and the positive aspects of health in order to support the development of healthy offices (see Chapter 1), this thesis builds on three studies; a scoping review (study 1), an explorative document analysis (study 2), and a mixed-method case study approach (study 3). An overview of the research approach for this thesis is presented in Table 1.

Table 1. Method overview of the licentiate thesis

	Study 1	Study 2	Study 3
Aim	Explore health and healthy office conceptualizations	Explore health and healthy office conceptualizations	Explore interrelations between employee SOC and the POE
Research question	How do office design approaches relate to health and healthy offices?	How is health addressed in relation to the POE from a Nordic perspective?	How does the POE influence employee SOC in the long term?
Method	Scoping review	Document analysis	Mixed-method case study approach
Context and setting	Literature from 4 databases, and 5 journals	Public documents published/funded by Nordic institutes	Interviews and observations
Result	Paper1	Paper 2	Working paper

3.1. Study 1

Study 1 involved a scoping review and resulted in paper 1. A scoping review aims to provide an overview of the existing literature on a topic area by scanning a wide range of literature on a subject area without assessing the quality of different studies (Pham *et al.*, 2014).

This scoping review adopted Arksey and O'Malley's (2005) framework which included the following five phases: (i) identifying the research questions; (ii) identifying relevant studies; (iii) study selection; (iv) extraction of data; and (vi) collating, summarizing and reporting the results.

The following *research question* was explored in the scoping review: How do ODAs relate to health and healthy offices? The scoping review aimed to identify the most prevalent building design features and aspects of health addressed by ODAs. It, therefore, explored the following subquestions:

- Which ODAs relate to health?
- Which health aspects are commonly discussed by ODAs?
- Which building design features are commonly discussed by ODAs?

In the *identification* phase, articles were collected through two types of searches: general database searches in four electronic databases, PubMed, Scopus, Google Scholar, and Web of Science, and manual journal searches within five journals, *Environment and Behavior (EAB), Journal of Facilities Management, Journal of Corporate Real Estate, Health Environments Research & Design Journal (HERD),* and *Intelligent Buildings International.*

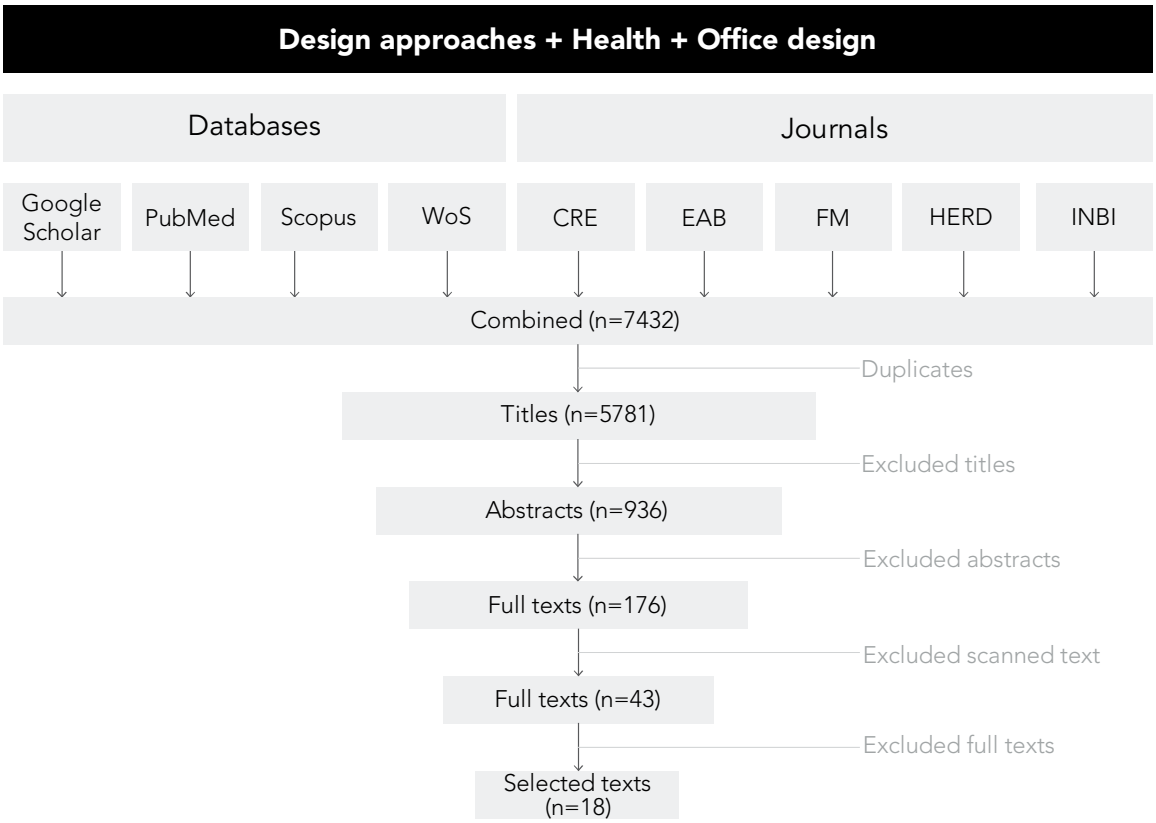

Figure 4. Flow diagram for selection procedure, originally developed for Forooraghi et al. (2020)

In the *selection* phase, the aim was to ensure that the included articles were relevant to the goals of the study. The papers should (1) address office design setting, (2) be written in English, (3) be published in the past 30 years (1988-2018), and (4) have prescriptive content. Ultimately, 18 papers met the inclusion criteria for further analysis addressing at least two of the key concepts: design approaches, health, and/or office design (Figure 4).

The details of the included publications were *extracted*, recorded in a spreadsheet and organized by columns corresponding to source information (authors, year), title, method, and summary text segments.

Content analyses on all 18 studies were performed to *collate* and *summarize* the findings (Krippendorff, 2003). This step helped to identify and map ODAs, their definitions, and goal orientations and addressed building design features and aspects of health. Finally, the design approaches were compared. This step allowed for the identification of discrepancies and similarities in the way design approaches are conceptualized and related to various health aspects and building design features.

3.2. Study 2

The second study was intended to complement study 1 and gain a better understanding of the Nordic perspective concerning health in office design. This study resulted in paper 2. The research method adopted an explorative document analysis approach involving a systematic procedure for reviewing published materials (Bowen, 2009). Document analysis is a time-efficient research tool as it does not require data collection but rather data selection which is often available in the public domain (Ibid).

The study was situated in the Nordic context, including institutes from Norway, Finland, Sweden, and Denmark. All data were collected between December 2018 and February 2019 from public reports and articles published/funded by Nordic institutes with a focus on workplaces. More documents were identified by analyzing the references of the major reports in the field. Subsequently, the literature that addressed the combination of health and workplaces was selected. The identified institutes were listed in a spread sheet including the name of the institute, a summary of their aims and the country. Their reports were collected mainly from their websites.

The details of the included documents were extracted into a charting form with respect to (i) source information (authors, year), (ii) title, (iii) country and objectives of the institute, (iv) target audience, and (vi) interpretations of health in the context of the office.

A critical analysis of the documents was performed (Stemler, 2001). The relevant texts were extracted and summarized, with a particular focus on commonalities and differences concerning the health perspective and aspects of the POE.

3.3. Study 3

Study 3 is part of a longitudinal project that focused on the relocation of an office in August 2017. This project consists of two phases: the first phase was carried out 6 months after relocation by my colleague, Cobaleda Cordero, and the second phase was carried out by me, 24 months after relocation (Figure 5). This project included a mixed-method case study approach (Creswell and Plano Clark, 2018) to investigate the influence of the POE on employee SOC in the long-term.

Data collection involved the following:

- Individual semi-structured interviews with employees and
- observations of the office environment in the context of use and occupancy.

The qualitative research approach was chosen to enable in-depth exploration of individuals' sense of coherence, setting out to collect employees' insights and experiences on how comprehensible, manageable, and meaningful their office was.

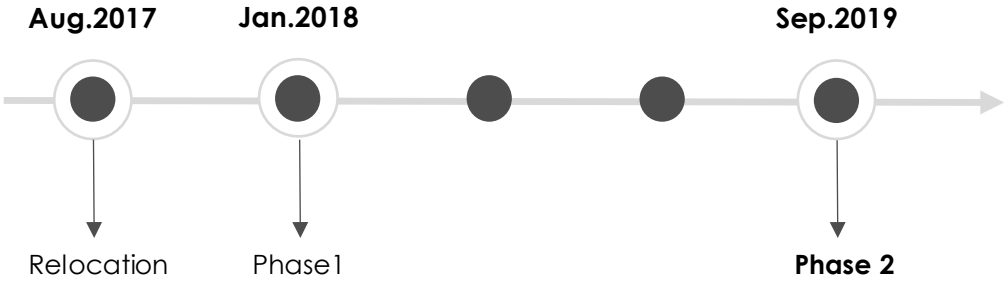

Figure 5. Illustration of the project timeline

Context. The case concerned a division with 42 employees from a university department in Sweden that had relocated to a renovated building from cell offices, along with 10 other divisions in summer 2017. The building had six floors, three of which were allocated to the staff of the university, and the rest was excluded from the study because it mostly was for educational purposes and other services. Employees were assigned to office rooms designed for two or eight employees, all of which faced outside. Back-up spaces included meeting rooms, phone booths, quiet rooms of different furnishing, flexible rooms, breakout areas, and balconies, most of which mainly faced a central atrium. All the rooms (office rooms and back-up spaces) were separated from the corridors with glass partitions. Employees had access to all shared facilities in the building. However, the offices of the division were located on the fourth floor.

Some changes had been applied to the spatial configuration of the office since the first phase and months after relocation: the quiet room with couches was turned into an office due to lack of workstations; curtains were added to the rooms facing the staircase on every floor to enhance visual seclusion; and couches in the lunchroom were moved to the other breakout areas and replaced by more chairs and tables for dining.

Data collection. The study followed the same procedure for data collection in both phases. That said, in this thesis, I focus on the second phase (follow-up). Data collection in this phase consisted of observations and semi-structured interviews with 17 employees, using the same approach as phase 1 (Cobaleda Cordero, Babapour and Karlsson, 2019, for comparison). Invitations to participate in interviews went out to all the employees. The participants included five women and twelve men, aged between 28-62 (median age of 34) and had different job positions including researcher, professor/lecturer, project leader, manager, and administrator. The interviews were held in meeting rooms at the studied office and lasted on average one hour. Architectural drawings, markers, blue-prints, sticky notes and a chart with some labels were used in the interviews. The annotations, notes and charts were collected and documented, and all interviews were recorded. The questions were designed to enable interviewees to share their insight concerning various aspects of the office, organization, their preferences, tasks and activities.

Observations were used to complement data collection with qualitative and quantitative data. The observations involved 18 rounds of going through all workspaces and making notes about occupancy and the use of different spaces, which was crosschecked with the inputs from interviews. Each round was conducted at different times of the day (8:00-10:00, 10:00-12:00, 13:00-15:00, 15:00-17:00) and different days of the week, corresponding to a regular working week at the office.

Data handling was treated confidentially; the names of interviewees were coded, and observation data were only used in an aggregated way. The preliminary findings from the analysis were presented during a lunch seminar in the division to obtain feedback and confirmation.

Data analysis. The 17 interviews were transcribed, and the content was coded using NVivo 12. The analysis used an inductive approach to identify recurring themes concerning employee experience in the office. The identified themes related to satisfaction with regard to IEQ, spatial and sociospatial features, social environment, organizational aspects, activities and individual preferences. For instance, 29 references from 17 interviewees referring to the spatial qualities of breakout spaces were coded into the node 'Break Facilities'.

The next step involved extracting motives for satisfaction with identified topics. This was followed by a deductive coding process. The motives for positive or negative perceptions of the identified features were further coded based on the SOC components including comprehensibility, manageability, and meaningfulness. For example, the 18 references from 13 informants referring to the theme of spatial diversity were identified to mainly influence the manageability component and to a lesser extent influenced meaningfulness, as they referred to a sense of control and choice of work settings.

The analysis followed a convergent design in which the two separate datasets from both phases were analyzed independently and were only brought together during the interpretation (Creswell and Plano Clark, 2018). That is, the findings were contrasted with the motives extracted from phase 1 to track changes in the way various features were perceived over time and how such perceptions related to the SOC framework. The changes were compiled into tables and presented in the findings section.

In summary, the research method and work addressed the research questions formulated for this thesis and resulted in research findings presented in the next chapter.

Chapter 4
Findings

This chapter provides a summary of findings from each study, involving: (i) identified ODAs and conceptualizations of health and healthy offices in the literature, (iii) from the Nordic perspective, and (iv) interrelations between the POE and employee SOC.

4.1. Office design approaches and health

RQ1. How do office design approaches relate to health and healthy offices?

The data from study 1 found a diverse range of ODAs. The findings of this study are presented with respect to the identified office design approaches, health aspects and healthy office conceptualizations and design features.

Office design approaches

The identified ODAs reflect diverse foci and goal orientations that can be grouped into three main themes: *health-focused*, *user-focused* and *office concepts*. The definitions and design goals are outlined in Table 2.

H*ealth-focused* ODAs indicated that the design should be created to improve and/or promote employee health, well-being or safety. While some papers characterized design approaches e.g., salutogenic design, active design, or participatory design (Heerwagen *et al.*, 1995; McGann *et al.*, 2014; Ruohomäki, Lahtinen and Reijula, 2015; Myerson and Ramster, 2017), others delineated the implications of different design decisions for employee health (Danko, Eshelman and Hedge, 1990; Oseland, 2009; Smith and Pitt, 2011).

U*ser-focused* approaches referred to the users and organizations as the center of the design activity. These approaches included user-centered, participatory or codesign and mainly focused on the process of

involving building users in planning and decision making to achieve an optimal design solution. For instance, Vischer (2008b) emphasized that buildings exist to support the activities of the users they shelter and viewed the relationship between user and environment as dynamic, in which the user is an active agent and consumer of the environment.

The activity-based flexible office (A-FO) was addressed by two papers as an *office concept* that aims to support employee activities by providing a set of various work locations (Brunia, De Been and van der Voordt, 2016; Wohlers and Hertel, 2016).

One paper reflected on evidence-based design and questioned the scientific rigor of such an approach in building design, namely offices (Sailer *et al.*, 2008).

Nevertheless, most approaches did not discuss outcome measures in relation to their design goals, especially those related to health. A lack of measurable outcomes and methods to measure was found in the literature. For example, most papers mentioned improving productivity, user engagement or collaboration as what design should achieve. However, they did not indicate whether they refer to subjective or objective aspects and how such outcomes could be measured.

Table 2. Definitions and goal orientations of ODAs

Design approach	Definition	Goal orientation
Health-focused		
A taxonomy of health DANKO ET AL. (1990)	–	Promoting physical and psychological well-being and safety through proactive interior design decisions
Environmental/Salutogenic design HEERWAGEN ET AL. (1995)	Adopts an interdisciplinary and ecological design process which looks at the interconnections among events, procedures, people, and places and considers both the absence of environmental stressors and the presence of particular kinds of features (nature, sunlight and daylight, windows, esthetic pleasantness, etc.).	Meeting basic needs related to individual and collective well-being through environmental features and interventions
Psychological needs and office OSELAND (2009)	–	Meeting the basic psychological needs of employees, such as comfort, safety, security and sense of belonging and supporting performance
Sustainable workplace design SMITH AND PITT (2011)	No definition is provided. A healthy working environment is defined as an environment that is free from negative health contaminants and where safety hazards are reduced to the minimum.	Contributing to improved health, satisfaction, productivity and well-being through sustainable design due to the improved quality of buildings
Active design MCGAN ET AL. (2014)	Analyzes the drivers of movement in different building layouts to identify opportunities in buildings that might affect incidental physical activity.	Promoting health through reducing sedentary behavior and increasing opportunities for physical activity in the workplace

Design approach	Definition	Goal orientation
Salutogenic, user-centered and participatory design RUOHOMÄKI ET AL. (2015)	A salutogenic approach considers the space and indoor environment and accepts the positive effects of work which may even promote well-being. A user-centered approach is a process in which the needs of the end-users of the product, service or process are given extensive attention at each stage of the design process. Participatory design refers to a design process in which different stakeholders are involved in improving either the design process or the final outcome of the process.	Promoting employee health and well-being through adopting a salutogenic, user-centered, and participatory approach for workplace design
Participatory design MYERSON AND RAMSTER (2017)	Sees designers working collaboratively with end users as equal partners to create, design and/or produce ideas, spaces, products, technologies or services.	Optimizing well-being in the workplace through meeting both the functional and psychological needs of the individual on an equal basis
User-focused		
Agile work environment BELL AND ANDERSON (1999)	Refers to easily adaptable, flexible and varied workspaces that can accommodate change.	Fostering collaboration, innovation and communication while attracting and retaining a highly talented workforce
Codesign/Participatory design DEWULF AND VAN MEEL (2002)	Gives users not only possibilities to express their opinions and ideas but also, decision-taking powers. In a participatory process, designers and consultants are the experts and users provide practical knowledge about the 'way things work' in organization and buildings.	Adding value to an organization's performance and enhancing users' sense of commitment; increasing user satisfaction and trust through better user involvement
Sustainable and flexible workplace HASSANAIN (2006)	Refers to both operating and maintaining the workplace in an environmentally responsible manner and offering physical layout that meets changing functional user or owner needs.	Ensuring that the workspace and its facilities are operated and maintained to enhance the individual, and corporate productivity, and the health and well-being of staff
Inclusive design ELRICH AND BICHARD (2008)	Focuses on the needs of "extreme" users to make design more accessible for all.	Meeting the needs of older knowledge workers through interventions, which will best facilitate their productivity and well-being
Evidence-based design SAILER ET AL. (2008)	Refers to making decisions—with an informed client—based on the best available information from credible research and evaluations of projects.	Meeting organization's and user's needs, e.g., providing effective and tailored solutions to client-specific problems

Design approach	Definition	Goal orientation
User-centered design VISCHER (2008a)	Builds the theory around the two key concepts of the building user's experience and the user–building relationship. Users are defined according to their use of the built environment, and thus users' experience becomes a measure of its effectiveness.	Creating a positive and supportive built environment that enhances human activities and helps people fulfil their aspirations
User-centered design IANEVA ET AL. (2015)	Seeks to involve users to ensure that the designed object meets their needs. Users are considered as "experts in use" (whose role is to inform and evaluate).	Achieving strategic goals, namely, transforming corporate identity, culture and business
Human-centered design CAWOOD ET AL. (2015)	No definition is provided, but it adopts an industry gold-standard human-centered design (HCD) process as described by the Stanford Design School and others.	Producing an effective design, and improving employee engagement, help build shared understanding across departments, help in the understanding of constraints and improve the level of satisfaction with the final workspace
Performance-oriented design KÄMPF-DERN AND KONKOL (2017)	The main dimensions include involved actors and performance parameters, the processes and success factors of implementation and change management of such workspace projects, with their interaction to be considered as well.	Enabling different work activities/processes and reflecting peoples' preferences and needs and show a fit to strategy and organizational culture
Office concept		
Activity-based Office BRUNIA ET AL. (2016)	Provides a variety of workplaces that best fit with the various activities of the employees and can address low-occupancy levels of personally assigned desks.	Increasing productivity due to improved collaboration and a better fit of activity-based workplaces with the variety of tasks and the psychological needs, such as autonomy, stimulating innovations, supporting (change in) culture and contributing to sustainability by reducing the footprint
Activity-based flexible office WOHLER AND HERTEL (2017)	Provides different working locations that match the requirements of different kinds of work activities.	Responding to emerging work requirements, often caused by the increasing emergence of knowledge work, by providing space for both concentrated work and opportunities for conversation and collaboration

Health and a healthy office

This scoping explored health aspects and healthy office characterizations by design approaches. The analysis revealed that most papers did not define/interpret health, nor did they characterize a healthy office. Exceptions were Ruohomäki, Lahtinen and Reijula (2015), which referred to the health and healthy workplace definitions introduced by the WHO (2010): "*A healthy workplace is one in which workers and managers collaborate to use a continual improvement process to protect and promote the health, safety and*

well-being of all workers and the sustainability of the workplace". In contrast, Smith and Pitt (2011), characterized a healthy work environment as being free from harm-causing factors where safety hazards are minimized, pointing in a pathogenic direction. That said, most included papers addressed various aspects of health, including *salutogenesis*, *well-being*, and *physical* and *mental health*.

Salutogenesis was found in few papers. Heerwagen *et al.* (1995) argued that to produce health-promoting outcomes, salutogenic environments include the absence of environmental stressors and the presence of features with a positive influence, such as increased personal control, contact with the natural environment, esthetically pleasing spaces, and spaces for relaxation for individuals and groups. Similarly, Ruohomäki, Lahtinen and Reijula (2015) linked the salutogenic approach to office design. However, they were less explicit about the ways in which the physical environment may support employee SOC. Danko *et al*. (1990) also reflected a salutogenic perspective on health being more than the mere absence of sickness while emphasizing long-term health outcomes in the workplace. Vischer (2008) did not explicitly mention the term *health* or *salutogenesis* but referred to "*a positive and supportive built environment which enhances human activities and helps people fulfill their aspirations*".

Several others referred to *well-being* or its notions. While some papers related environmental and spatial features to mood, affect, comfort, and satisfaction (Heerwagen *et al.*, 1995; Dewulf and van Meel, 2002; Oseland, 2009; Smith and Pitt, 2011; Wohlers and Hertel, 2016), Vischer (2008) questioned whether such measures are meaningful enough to evaluate the interrelation between people and the environment. She instead addressed personal growth and meaning as being more reliable measures for office environment assessments. However, such aspects were not abundant in the literature. Only a few studies addressed cultural and collective meaning through incorporating symbols and items of group identity or providing life management amenities in the workplace (Danko, Eshelman and Hedge, 1990; Heerwagen *et al.*, 1995).

Physical health was addressed mainly by the symptoms of sick building syndromes, musculoskeletal injuries, or safety and hygiene (Danko, Eshelman and Hedge, 1990; Heerwagen *et al.*, 1995; Ruohomäki, Lahtinen and Reijula, 2015). Another aspect is related to active design through reducing sedentary behavior and increasing opportunities for more physical activity within the working day (Danko, Eshelman and Hedge, 1990; Heerwagen *et al.*, 1995; McGann *et al.*, 2014). *Mental health* included environmental stressors, such as lack of control over the environment, and psychophysiological outcomes, such as anxiety and depression (Danko *et al.*, 1990; Heerwagen *et al.*, 1995).

Office design features

The design approaches found in the literature addressed multiple design strategies and features, which are grouped as *IEQ features*, *spatial features, sociospatial features,* and *social features*. In addition, the analysis identified a few nonphysical factors that related to the context of organizations, individuals and work processes.

IEQ features referred to the need for a good thermal environment, fresh indoor air, access to daylight and artificial lighting, low noise level and acoustic quality (Danko *et al.*, 1990; Heerwagen *et al.*, 1995; Hassanain, 2006; Oseland, 2009; Smith and Pitt, 2011; Ruohomäki *et al.*, 2015; Brunia *et al.*, 2016; Kämpf-Dern and Konkol, 2017; Myerson and Ramster, 2017).

Spatial features referred to interior design choices and physical layout. For instance, several papers focused on enriching the work environment by using paintings, posters, textures and colors, elements of the natural environment, or proper storage space to reduce visual clutter (Heerwagen *et al.*, 1995; Hassanain, 2006;

Oseland, 2009; Smith and Pitt, 2011; Brunia, De Been and van der Voordt, 2016; Kämpf-Dern and Konkol, 2017; Myerson and Ramster, 2017). Others addressed strategies to promote physical activities, such as recreational courts, garden paths, and bicycle racks (Danko, Eshelman and Hedge, 1990).

Sociospatial features included a sense of control, privacy and territoriality, and were supported by different design strategies. For instance, several authors suggested providing 'space for various types of work' as a design strategy to support employee sense of control, without explicitly defining the spatial qualities. Depending on the design goals, these space types aim to support individual preferences (Hassanain, 2006; Erlich and Bichard, 2008), activities (Heerwagen *et al.*, 1995; Bell and Anderson, 1999; Myerson and Ramster, 2017) or both (Danko *et al.*, 1990; Oseland, 2009; Brunia *et al.*, 2016;). Opportunities for user empowerment were expressed through involving them in the design process at three levels: informing users about workplace interventions, including user input for designers' work (participatory design) and involving users in the formal decision-making process (codesign) (Dewulf and van Meel, 2002). Additionally, design ideas to support visual and acoustic privacy were discussed with different levels of abstractions, for instance, planning office zones according to their sources of noise (Danko, Eshelman and Hedge, 1990) or avoiding a feeling of being looked over by not locating occupants with their backs to a main circulation route (Oseland, 2009). A sense of ownership was often expressed through the personalization of individual or group space (Ruohomäki *et al.*, 2015; Kämpf-Dern and Konkol, 2017).

Social features referred to the capacity of the POE to support or enable social interactions. Several authors explicitly stated that workplaces should enable communication, collaboration and learning, particularly, spontaneous discussions through informal meeting spaces (Heerwagen et al., 1995; Bell and Anderson, 1999; Ianeva, Chotel and Miriel, 2007; Oseland, 2009; Ruohomäki, Lahtinen and Reijula, 2015; Cawood et al., 2016; Kämpf-Dern and Konkol, 2017).

Some of the identified features referred to *contextual factors*. These features often play a critical role in the person-environment relationship, relating to individuals, tasks, or organizations. The individual-related features included age, gender, personal preferences and personality traits (Ianeva, Chotel and Miriel, 2007; Erlich and Bichard, 2008; Wohlers and Hertel, 2016; Kämpf-Dern and Konkol, 2017). Moreover, task variety, work styles and activity profiles were mentioned as influencing factors in how employees perceive certain office types (Bell and Anderson, 1999; Ianeva, Chotel and Miriel, 2007; Vischer, 2008a; Ruohomäki, Lahtinen and Reijula, 2015; Brunia, De Been and van der Voordt, 2016; Wohlers and Hertel, 2016; Kämpf-Dern and Konkol, 2017). It was also indicated that certain organizational cultures (e.g., restricted employee autonomy) that are driven by different logic and hierarchies can overcome the spatial settings, and thus, these may not benefit from, for instance, flexible spatial design (Sailer *et al.*, 2008; Wohlers and Hertel, 2016). *Productivity* and *performance* were addressed frequently as organizational outcomes, often paired with health and well-being, but without accompanying definitions (Danko *et al.*, 1990; Heerwagen *et al.*, 1995; Erlich and Bichard, 2008; Cawood *et al.*, 2016; Wohlers and Hertel, 2017). An exception was the work of Kämpf-Dern and Konkol (2017), describing performance as "*the degree to which stated objectives are being achieved* or *the relationship between forecast and executed work*".

4.2. The Nordic perspective

RQ2. How is health addressed in relation to the POE from a Nordic perspective?

Study 2 set out to explore how literature in Nordic countries relates to health and a healthy office, carried out as a complement to study 1.

The definitions and interpretations of health were not abundant in the selected Nordic literature. Although all the included documents used the term health, only one referred to the WHO's definition (Ruohomäki, Lahtinen and Reijula, 2015). Another article interpreted health as to "*feel good and have sufficient resources to meet everyday demands and to be able to realize both personal and professional goals*" (Hultberg *et al.*, 2017). This interpretation reflects a salutogenic orientation, more specifically manageability aspects in the SOC framework. This report also added that a health-promoting workplace "*should offer good working conditions, a good working climate and provide the preconditions for personal and professional development*".

Others referred to health-related outcomes, representing two different health perspectives:

- A biomedical and pathogenic orientation focusing on removing negative influences and stressors e.g., physiological stress reactions, fatigue and absenteeism and
- a salutogenic perspective referring to the presence of positive factors that create health and not the mere absence of disease also known as positive health, e.g., coping, motivation, workability, work engagement, and job satisfaction.

The health perspective found concerning the POE was mainly dominated by a biomedical and pathogenic orientation, thus traditional risk-oriented health outcomes, such as increased stress, fatigue, general health, lower motivation and physiological reactions from the heart and vasculature. For example, Bakke and Fostervold (2017) explored the impact of open-plan offices on health, well-being, and productivity and identified several influencing factors in the literature, such as ventilation, acoustics, ergonomics, daylight, privacy, and control. They also highlighted the importance of spaces for recovery in workplaces to return to the poststress level. Exceptions were Ruohomäki et al. (2015), which outlined the social, psychological and social dimensions of the workplace that promote health and well-being. These aspects included a good indoor environment, support of tasks and work processes, ergonomics and accessibility, attention to privacy and the need for personal space. The article also emphasized strengthening a sense of control and enhancing work engagement, and mutual learning.

The positive health approaches, namely, workplace health promotion, were found to focus on psychosocial work environments (Hultberg *et al.*, 2017) or healthy behaviors (Kwak *et al.*, 2017), while the role of the physical environment was limited to promoting access to healthy food and facilities for increased activities. Additionally, these documents were targeted toward, e.g., human resources, occupational health professionals, safety representatives, and students while neglecting architects and designers who play a major role in the creation of the POE.

Finally, the included documents represented a variety of research orientations. The focus of the articles often varied depending on the institutes' disciplinary focus. For instance, while some focused on the impact of the psychosocial environments, e.g., relationships among colleagues and their managers on positive health outcomes (salutogenic) (Hultberg *et al.*, 2017), others, starting from an architectural perspective, focused on negative health impacts (pathogenic) in relation to the office type, function, spatial and esthetic features, as well as IEQ factors (Ruohomäki, Lahtinen and Reijula, 2015; Toivanen, 2015; Bakke and Fostervold, 2017). One document had a management-oriented direction studying how Nordic managers understand workplace design and its role as a strategic tool for knowledge sharing without addressing health (Bakke and Telenor Research and Innovation, 2007).

The findings of this review also highlighted the limited attention paid to the potential of the POE for promoting the positive aspects of health.

4.3. Sense of coherence in the office

RQ3. How does the POE influence employee SOC in the long term?

Study 3 explored interrelations between employee SOC and the POE in the long term. The findings are presented in three parts: the first part describes design features of the POE, the influence of which was consistent throughout both phases. The second part describes the changes in terms of features that became either more positive or negative from a SOC perspective. Finally, the third part includes contextual factors related to the characteristics of the organization, the individuals and their tasks and activities. While the scope of the study concerned the POE, these aspects were critical to contextualize the findings. Table 3 presents an overview of the features and their influence on sense of coherence.

Design features with consistent influence on SOC

In general, several design features of the POE were found to have a consistent influence on the SOC of employees throughout both phases. These features included aspects that positively influenced manageability and meaningfulness, such as breakout spaces and meeting rooms, which were described by interviewees as "bright", "spacious", and "relaxing" with "nice views" to outside, "high-quality furniture" and access to coffee machines.

Some design features were found that either positively or negatively influenced the manageability and meaningfulness component, such as the level of spatial seclusion. Nearly half of interviewees perceived exposure to visual and acoustic stimuli as an obstacle to their concentration and productivity. However, the others half felt less sensitive and viewed such exposures as "good for the exchange of information". Additionally, several interviewees (9/17) reported adopting various coping strategies such as the use of noise-canceling headphones and separating panels. It is also worth noting that some office rooms and workstations had a higher degree of seclusion due to their locations which contributed to better privacy and a sense of control over the external stimuli. Another aspect influencing manageability and meaningfulness related to the opportunities for workspace personalization. Interviewees had diverse insights. While almost half of interviewees expressed satisfaction with current opportunities, others indicated dissatisfaction, due to the shared nature of the office rooms requiring collective agreements for changes. Similarly, opinions differed in terms of indoor temperature, with nearly half of interviewees perceiving it 'too cold', while the rest indicated satisfaction with it.

Design features with short-term influence on SOC

In general, the employees perceived the office more positively in phase 1 in comparison with phase 2. In phase 1, the majority of interviewees (14/16) reported feeling "nice", "better", "happier" or "comfortable" in the 'new' office, which contributed to a higher level of motivation and energy. However, in phase 2, perceptions became more divided about several positive influences of the POE mainly relating to the manageability and meaningfulness components.

For instance, while the findings from six months after relocation indicated that the 'new' office facilitated more social interactions compared to the previous office, several interviewees (13/17) reported difficulties in meeting colleagues in the follow-up phase. The motives related to lack of a division-specific space as a centralized meeting point, the abundance of spaces that spread people around, and the capacity of most breakout areas that did not allow for a large number of people to gather. This sometimes led to a feeling of isolation and a lack of sense of belonging influencing the meaningfulness component of the SOC. Similarly, spatial diversity was regarded as having a mainly positive influence on manageability in phase 1 however, in the follow-up phase, the interviewees referred to it either positively or negatively. Some appreciated the number of types of spaces for different functions, whereas others mentioned a lack of diversity to cater to various activities, such as individual and project work or sports facilities. In addition, the spatial qualities of most back-up spaces were homogenous and did not offer different degrees of visual and acoustic seclusion, indicating a negative influence on manageability. Furthermore, nearly one third of interviewees seemed less impressed by the look and esthetics of the office over time, citing a lack of texture, greenery and a homie feeling. This mainly influenced the meaningfulness component.

Nevertheless, the influence of a few design features became more positive over time. For instance, the proximity of storage to workstations and the amount of space helped employees feel that they have access to all their belongings. Exceptions were two interviewees who perceived the storage space to be insufficient for their needs. In addition, the furniture of the workstations, meeting rooms and breakout spaces were considered "comfortable", "luxurious" and of high quality. These features were found to positively influence the manageability and meaningfulness components of SOC.

A few design features were recurrent in only one of the phases. For instance, an insufficient number of power outlets or exposure to sun glare were negatively perceived in phase 1 but were seldom mentioned in the follow-up phase. Exception were two interviewees, who expressed dissatisfaction with the automated shadings not protecting their screens from glare. In addition, spatial comprehensibility in terms of wayfinding was perceived problematic in phase 1. Nevertheless, this was rarely mentioned in the follow-up phase with some exceptions indicating that indoor navigation became easier after getting more familiar with the spatial configurations and the labeling system over time. An emerging issue in phase 2 was related to the lack of behavioral rules in the office, which contributed to ambiguities concerning order and cleanliness. Rules and the expected behavior were not defined/agreed on before the relocation. Discussions within the division took place before the move; however, the outcomes were not formalized. As a result, the interviewees expressed conflicting interpretations of individual responsibilities in relation to office maintenance. Although in some cases, signs were put up, these were not complied with, leading to visual clutter and messiness which was apparent in the observations. This uncertainty also influenced the comprehensibility of the office. However, most interviewees suggested that such rules should be developed either based on common sense or discussions among colleagues. Furthermore, the lack of individual control over temperature, automated shading system and stimuli were described as "stressful" or "annoying" decreasing the level of manageability in the office.

Contextual aspects

Various contextual factors were identified that helped to explain the reasons behind the way employees experienced the office environment. The main factors were related to employee autonomy, facility management, individual preferences, and their activities. In terms of autonomy, the organization had a trust-based working model in which employees were free to choose when and where to work.

Table 3. Overview of influence of design features on sense of coherence

Design features	Changes in influence	Sense of Coherence		
		Comprehensibility	Manageability	Meaningfulness
Meeting rooms	Positive →Positive		+	+
Breakout areas	Positive →Positive		+	+
Exposure to visual distractions	Negative →Negative		–	
Division specific breakout space	Negative →Negative		±	
Temperature	Divergent →Divergent		±	
Exposure to acoustic stimuli	Divergent →Divergent		±	
Level of spatial seclusion	Divergent →Divergent		±	±
Space personalization	Divergent →Divergent	±	±	±
Daylight	Positive →Divergent		–	
Social environment	Positive →Divergent			±
Esthetics	Positive →Divergent		±	±
Spatial diversity	Positive →Divergent		±	±
Furniture	Divergent →Positive		+	+
Personal storage	Divergent →Positive		+	+
Sun glare	Only recurrent in phase 1		–	
Wayfinding	Only recurrent in phase 1	–		
Control over the environment	Only recurrent in phase 2		–	
Lack of behavioral rules	Only recurrent in phase 2	±		

+ Positive influence; - Negative influence; ± Positive and negative influence

The majority of interviewees (13/17) highly valued their level of autonomy and several (8/17) regarded this flexibility as the best of their job situation and beneficial to their work-life management. Furthermore, this working model seemed to have a compensating effect on the lack of control over visual and noise stimuli, allowing employees to work remotely or avoid peak hours in the office. This seemed to positively influence employee manageability. Regarding facility management, interviewees did not feel involved in the process of changes, such as the planning process, refurnishing of the lunchroom, adding curtains to cover the glass partitions in some office rooms or replacing the quiet room. In addition, over one third of interviewees considered the style of the facility management ambiguous and often irresponsive to faulty reports especially concerning automated shadings, adding to the challenges for comprehensibility in the office. In terms of individual preferences, the needs varied among interviewees. Some were less sensitive to stimuli and some had experienced better or worse conditions in their former workplaces which influenced their expectations of the current office. In terms of workstyles, the level of task variety differed among interviewees influencing their choice of work setting; in most cases, this choice was their own desk.

Chapter 5
Discussions

The aim of this thesis is to explore the interrelations between the POE and the positive aspects of health to support the development of healthy offices. Based on the findings and considering previous research, I will discuss the following points:

- Understanding of health and a healthy office
- Holistic design approaches and contextual aspects
- Designing for long-term impact

Understanding of health and a healthy office

The findings indicate an overall lack of definitions and/or interpretations of health and a healthy office, as well as discussions concerning the evaluations of these concepts. Although health and well-being were mentioned in the papers, only one paper referred to the definitions of health and healthy workplaces by the WHO (Ruohomäki, Lahtinen and Reijula, 2015). This finding aligns with a recent review on healthy workplaces that also noted the lack of papers defining health while calling for definitions of the key concepts being studied (Jensen and van der Voordt, 2019). The lack of definitions of health in the literature might have arisen from an assumption that health as a concept is already known, often as common biomedical health. On other occasions, the term 'health' or 'well-being' may have been used as a synonym of something generally 'good'.

The findings also suggest narrow views on health and long-term outcomes, often limited to the absence of disease (pathogenic), and little attention has been given to the positive dimensions of health (salutogenic). One possible reason could be related to the dominant pathogenic orientation in the study of health in relation to the POE, largely focusing on employees' general health, stress, or sick building syndrome (Appel-Meulenbroek *et al.*, 2018). This eventually has resulted in design strategies with a narrow view of problems

and solutions, namely, focusing on lifestyle choices such as physical activities. The previous research highlighted such narrow focuses on ill health as a common problem in the built environment calling for more enabling approaches (Bluyssen, 2014).

As outlined in the introduction, a practical question today is to understand how offices should be designed and managed to support or promote health. This question cannot be suitably answered by studies that do not clearly elucidate their perspective on health and a healthy office. In fact, lack of clarification may simply result in perpetuating the existing pathogenic paradigm in the healthy office development. It is therefore imperative for future studies to provide their definitions of health, as health orientation often determines research focus and thereby influences health-related policies in the longer run (Torp and Vinje, 2014).

Holistic design approaches and contextual aspects

It is perhaps unsurprising that several design approaches found in the literature search are rooted in other well-established research disciplines, such as health care or ergonomics. What is surprising is the limited number of health-focused ODAs that focus on the positive aspects of health. Instead, the literature placed a considerable emphasis on productivity, often accompanied by the terms 'health' and 'well-being'. While productivity is linked to employee health (Clements-Croome, 2018), the relationship is not always overlapping or symbiotic (WGBC, 2014). The risks and symptoms caused by the work environment can take days, weeks or months to manifest themselves (Heerwagen *et al.*, 1995); thus, one can be ill but still productive, at least in the short term. Nevertheless, office studies often take only a few days due to limited resources and follow-up studies with a focus on long-term impact on health are rare. Therefore, it might be useful for future research to address health and its environmental resources independently from productivity.

Most design strategies were formulated with relatively little attention paid to the contextual factors related to organizations, individuals or job characteristics. For instance, a great deal of the literature supported employee sense of control by providing a variety of spaces for different activities; however, it was often ambiguous whether these spaces should be designed based on 'activity' or 'personal preferences'. The lack of clarity concerning design strategies could result in mismatches between individual preferences and space. This finding may reflect the lack of detailed contextual insights about individual circumstances and their activities when studying office environments (Babapour, 2019). Another example is organizational culture in terms of the level of hierarchy that may play a critical role in whether certain office types (e.g., A-FOs) are suitable for an organization (Sailer *et al.*, 2008; Wohlers and Hertel, 2016). This lack of knowledge about such contextual factors, which decide whether a given concept will succeed or not, leads to inconsistency in the research findings in the field. In other words, the evaluation of the POE is complex, and if potential contextual factors are not taken into consideration when studying offices, then they can easily become confounding variables.

A notable finding is that no overarching approach to healthy office design was found to holistically incorporate neither all building design features nor various health aspects. For instance, most *user-focused* approaches were characterized around design processes overlooking sociospatial features, or *health-focused* approaches often failed to consider factors related to individuals and their job characteristics as well as change processes. Hence, in the absence of holistic ODAs, practitioners and researchers may want to use such approaches in combination, similar to how Ruohomäki, Lahtinen and Reijula (2015) combined salutogenic, user-centered, and participatory design.

Most ODAs formulated design goals concerning employees and organizations but failed to specifically discuss how such goals should be evaluated. While outcomes such as improved health, productivity or collaboration are assumed to be a result of ODA applications, there are limited empirical studies on the in-depth analysis and validation of such assumptions. Hence, post-occupancy studies might provide a good evidence base in this regard. That said, lack of operating definitions of design approaches might pose a challenge, leading to different solutions, despite using the same vocabulary.

Designing for a long-term impact

The findings indicated interrelations between employee SOC and the POE. Manageability and meaningfulness were the main components of SOC influenced by the POE. Furthermore, the comprehensibility component was mainly influenced by the lack of clarity and behavioral rules. Employee autonomy, facility management, and individual preferences were critical to elucidate these findings.

The findings revealed that the *manageability* component was greatly influenced by a sense of control over ones' immediate environment. Throughout both phases, the lack of control over the automated shadings, temperature and stimuli led to a feeling of discomfort and distractions, which eventually can lead to learned helplessness (McCoy and Evans, 2005). Despite phase 1, spatial diversity had less of a contribution to a sense of control in phase 2. Most interviewees preferred working at their own desk over back-up spaces as the observation data also confirm. It is noteworthy that the interviewees recurrently mentioned their own workstations as one of their favorite places in the office, which was consistent throughout both phases. Back-up spaces, such as quiet rooms or flex rooms, were not perceived as advantageous over their own workstations due to a lack of dual screens, privacy, implied ownership and the degree of task variety.

Nevertheless, the trust-based working culture of the organization enabled a high level of autonomy (employees' control of time and place of working; e.g., Demerouti *et al.*, 2014) that may have moderated the negative impact of shortcomings concerning the lack of sense of control over the environment. Previous research has associated autonomy with a positive impact on well-being, job satisfaction, and work motivation (e.g., Ilardi *et al.*, 1993; Gagné, Senécal and Koestner, 1997; Deci and Ryan, 2008). In other words, the high level of autonomy empowered employees by extending their resources for coping with visual and acoustic distractions in terms of freedom of work scheduling and choice of work environments.

Therefore, it is essential that designers and decision makers work to strengthen the manageability component of SOC by enabling employees to craft a suitable environment for their needs. This includes providing a variety of work setting choices that are designed with attention to employees' needs and preferences concerning furniture, IT infrastructure, privacy and control options over one's immediate environment.

In terms of *meaningfulness*, the social environment and a sense of ownership were found to be the main influences. While in phase 1, interviewees perceived that the open and various spaces led to more social interactions than in the previous office, in phase 2, surprisingly, more than half of interviewees found it difficult to socially interact with colleagues. Interviewees indicated that it was easier to meet colleagues over coffee breaks in the previous office, despite being highly satisfied with the breakout spaces and their spatial qualities (e.g., daylight, views, furniture, and proximity). This may be due to the lack of sense of ownership over the breakout areas because the floor accommodated several divisions, and thus the space did not allow for personalization as it did in the previous office, where postcards and pictures of colleagues were used to assert meaning to the space and express group identity. This finding is in line with other studies highlighting the importance of personalization of space as a means of making sense of the environment (Brunia and

Hartjes-Gosselink, 2009). Furthermore, the minimalistic esthetics of the office was perceived as 'sterile' or 'homogenous' for several interviewees and did not evoke meaning. As Golembiewski (2010) indicates, reduced environments are linked to depression and confusion, and in contrast, an enriched environment is associated with improvements in emotional, cognitive and immune system functions. An outcome of this finding is that designers and facility managers might consider the long-term impact of reduced environments and offer a level of flexibility for collective identity expressions.

The findings showed that the *comprehensibility* component was mainly influenced by ambiguity in facility management style and lack of behavioral rules. The interviewees perceived a limited possibility to influence design decisions in the planning process. Additionally, the interventions in the POE, after relocation, were often implemented without employees being aware of or involved in the decision-making process. Furthermore, confusion about the maintenance system often added to uncertainty (who is in charge of what). This lack of involvement also overlaps with the manageability component, as employees felt having little control over office interventions. Previous studies have already indicated that limited user involvement in the planning process leads to increased mismatches between employees' needs and the designed space, and thus, employee involvement in the process of change has been found to be critical for successful implementations (e.g., Vischer, 2008b; Lahtinen *et al.*, 2015; Hongisto *et al.*, 2016; Rolfö, 2018; Babapour and Rolfö, 2019).

Finally, the lack of rules concerning the expected behavior was found to influence interviewees either positively or negatively. Research has emphasized the role of well-defined and explicit policies (Babapour, Karlsson and Osvalder, 2018; Babapour, Harder and Bodin Danielsson, 2020). This thesis also underlines the need for policies, especially in flexible shared offices, as part of the implementation process and change management, as such ambiguity might lead to feelings of discomfort and frustration toward colleagues.

5.1. Limitations

The main limitations of this work concern the qualitative data, sample size and the high level of details.

First, the scoping review (study 1) provided an overview of a specific subject area (ODAs) without intending to assess the quality of the included literature. Moreover, the findings were the result of the chosen keywords and search strategies which might have been different in other research teams. However, the continuous discussions among authors and consultations from the university librarians regarding the choice of keywords and search strategies contributed to the liability of the method.

Second, it has been recommended to complement a document analysis with other sources of data (Bowen, 2009). In this case, (study 2), due to the narrow focus of the study on the Nordic context, document analysis was used as a complement to study 1. Moreover, the differences between Nordic countries should be recognized, particularly with regard to public health challenges and research (Torp and Vinje, 2014); therefore a regional approach might not capture specific nuances. That said, due to the similar culture and socioeconomic conditions, the regional focus was chosen to more closely study the topic.

Third, while the sample size and the high level of details included in the case study (study 3) limit the possibility of generalizing the results, the resolution of the findings is improved, contributing to a more accurate comparability among various cases.

Fourth, the methodological approach adopted for the case study does not allow for the establishment of causal associations between the POE and employee SOC. Instead, this work should be seen as a complement

to larger sample sizes and statistical evidence bases, unfolding multidimensional aspects of the POE in relation to health.

Finally, this thesis focused on the POE, despite the complexity of the sociotechnical system involved. That is, in this work, the features involved in the physical environment are addressed in relation to comprehensibility, manageability and meaningfulness and other contextual aspects such as the characteristics of the organization, individuals and their tasks and activities were only reported when found relevant to the influence of the POE.

Chapter 6
Conclusions

This thesis explored the interrelations between the POE and the positive aspects of health to support the development of healthy offices.

The two reviews explored the literature in the international and Nordic contexts. The findings revealed that conceptualizations of health and healthy offices were not abundant, and most approaches were limited to a pathogenic perspective. Hence, the empirical application of the salutogenic approach in office post-occupancy studies was suggested. Furthermore, health-focused ODAs were scarce and design strategies were often formulated with little consideration given to contextual factors. That is, no holistic ODA was found to address all design features and health aspects. Thus, it was suggested that ODAs be adopted in combination with one another.

In continuation of the literature reviews, the case study enabled an in-depth exploration of individual experiences of the POE with regard to SOC. This longitudinal investigation contributes to the previous research on healthy offices, especially with respect to long-term outcomes. The case study managed to illustrate the ways in which the POE influences employee SOC and follow up on such influences over the course of two years. Overall, the office was perceived more positively six months after relocation than 24 months after relocation. From an SOC perspective, manageability and meaningfulness were the most recurrently influenced by the POE. Comprehensibility was also influenced, however, mainly by lack of behavioral rules and clarity. This suggested that for long-lasting impacts, opportunities for a sense of control and identity expressions should be considered in addition to spatial qualities such as good layout, furniture, daylight and views. Furthermore, employee involvement in the change processes is critical to successful implementations. Contextual aspects were also vital to further explain employee experiences with regard to the findings.

In conclusion, I emphasize the importance of holistic approaches to office design. To develop healthy offices, there is a need to adopt a holistic approach, one that goes beyond the mitigation of pathogenic

aspects of the work environment and promotes the salutogenic resources of the environment to strengthen employees' SOC and empower them to deal with stressors more positively and adaptively. Salutogenic resources should ensure that employees have control in terms of tools and equipment as well as their own territory and privacy and involve them in decision-making processes (manageability). Furthermore, flexible offices should be designed with a focus on contextual factors involving the characteristics of organizations, individuals and work processes. The resources should ensure that there is adequate clarity about behavioral rules and information explaining how things work in an organization and who is in charge of what (comprehensibility). Finally, the resources should offer enriched meeting and breakout spaces in combination with opportunities for identity expressions as individuals and groups (meaningfulness).

Therefore, the move toward the healthy continuum in the office environment involves two complementary strategies: first, physical modifications can be made to the office aimed at alleviating risk factors (e.g., improving air quality) and second, maximizing the presence of salutogenic resources (e.g., optimizing a sense of control).

6.1. Implications and further work

As shown in this thesis, the relationship between health and the POE is heterogeneous and often involves more than one aspect. Therefore, the themes identified in the literature reviews and the case study should be interpreted as an opportunity to initiate discussion within the academic community, concerning their applicability and whether the salutogenic perspective is glaringly missing in the field of POE research. Several recommendations can be made for future evidence-based research addressing the POE and health:

- Define/interpret health and characterize healthy office design in a clear and unambiguous manner. Studies may consider borrowing definitions from other settings of the built environment. Learning how health is viewed and experienced in the varied environments of homes, hospitals or schools could be instructive. In practical terms, such setting-related insights might supplement the existing knowledge base to address context-dependent notions of health, more specifically SOC.
- Make a clear distinction between design goals (the stated aims that the design is created to facilitate) and expected outcomes (the indicators). This is particularly important for evaluating whether applying specific design approaches and frameworks (explored in study 1) will lead to more positive health outcomes. Similarly, the salutogenic approach has not been adopted in previous post-occupancy studies; thus, the findings in study 3 need to be empirically confirmed with a larger sample size.
- Another potential avenue would be to consider using established theories and methods from other disciplines (e.g., health care) to study health impacts. That said, the differences between science and design practice should be recognized, as every building is different, inhabiting a unique organization.
- To add clarity and comparability to future office evaluation, contextual aspects, such as task variety, organizational culture, gender or individual preferences and change processes can be incorporated to further explain employees' experience in the work environment (it is worth noting that no single study is likely to include all contextual aspects of the office environment at once).

While the present thesis, with a theoretical foundation, is directed toward the academic community, my future work will continue with the aim of translating the research findings to design strategies and solutions

to contribute to the development of healthy offices. Hence, I would like to investigate the following topics in the remaining phase of my Ph.D. project.

To improve the credibility of the findings of this thesis, expanding the sample size is key. A case study was carried out in a university office building with more than 200 employees. A mixed-method approach was adopted, and data were collected using a questionnaire, semi-structured interviews and observations. The analysis will focus on the interrelations between SOC, individual preferences and gender differences. As previously discussed, studies providing detailed contextual insights about individual circumstances and their activities are rare (Babapour, 2019), which eventually lead to mismatches and thereby low occupancy. Furthermore, gender differences have also been an understudied topic not only in office research but also in other fields. A recent ground-breaking book by Caroline Criado Perez revealed a lack of gender-specific data, termed the "gender data gap". In her book, she points out that most offices are adapted to the metabolic rate of an average 40-year-old, 70-kg man (Criado Perez, 2019). In recent years, the mainstream media has taken up the gender aspect of office temperatures (Sanghani, 2015; Belluck, 2015), which has led to women sharing their experiences concerning the thermal environment by tweeting and sharing pictures of them wearing extra blankets and clothing and using extra heaters in their workplaces. Furthermore, the WHO (1998, 2006b) recognizes gender norms and inequalities as social determinants of health and critical for public health research. Hence, the study of gender differences in the way(s) the POE influences SOC can address the knowledge gaps in this field.

Another case study is planned to investigate the office of a different type of profession. Most studies in the field of the POE focus on office layout from a design perspective instead of studying layout use (Appel-Meulenbroek, et al., 2018). Therefore, this study will explore how employees' individual preferences, their use of office space relate to their experience of sense of coherence. Finally, a cross-case analysis of the collected data will be performed, comparing the perceptions of SOC between the two case studies.

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